Filling the Gaps
Climate and Weather Information for Small- and Medium-size Water Utilities

Summary of Information and Research Needs

Project Objectives

- **Improve our understanding of the information needs of smaller water system managers**
- **Raise regional-scale awareness of NOAA's tools and information resources**
- **Build regional connections that support water sector decision making**
- **Identify ways to improve the Water Resources Dashboard and other NOAA climate and weather information resources for use in the water sectors**

Project Overview and Method

This workshop series was designed by the National Oceanic and Atmospheric Administration (NOAA) and the Water Research Foundation (WRF) to improve the delivery of NOAA's information resources to small- to medium-size communities, with the goal of building their resilience to climate change. Eight regional workshops were organized by NOAA's regional RISA or Regional Climate Center teams in consultation with the project team and were tailored to address issues identified by and for each region. Attendees included community drinking water and wastewater utilities, stormwater managers, urban planners, public works departments, etc.

Project Website

https://cpo.noaa.gov/Meet-the-Divisions/Climate-and-Societal-Interactions/Water-Resources/Water-Utility-Study

Preface/Caveats

- Needs expressed here are from 900 workshop participants
- It is possible NOAA, NASA, USGS, EPA or other agencies have the requested information already available.
- If so, it may be a matter of:
  a. Communicating availability to this sector
  b. Information is not readily findable
  c. The information may not be 'user friendly' for non-experts
  d. This sector may need training on how to apply the information for their scale or purpose
- If you know of its availability, our team would like to work with you to make it more accessible or useable for local communities

Information and Research Needs: Climatology

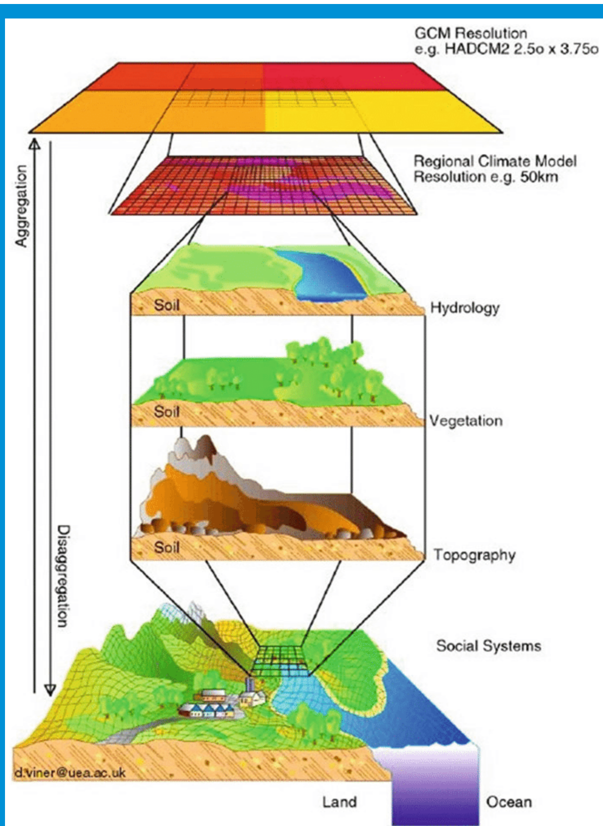
Observational Capabilities

- More hourly and sub-hourly rain gauges in mountainous areas
  - To input data into hydrologic flow models
- Historic hourly rainfall data at a useful spatial scale
  - For hydrology and hydraulic use
- Updated precipitation return period tables derived from the historical record
  - For infrastructure design and long-range planning
- Documentation of shifts in temperature, including warmer low temperatures as well as hotter high temperatures

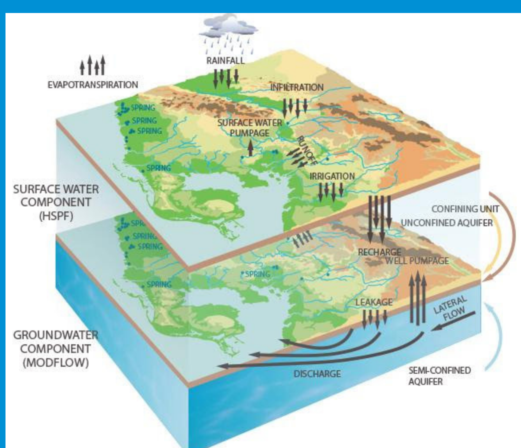
Current and Near-Term Weather Information

For preparedness and response

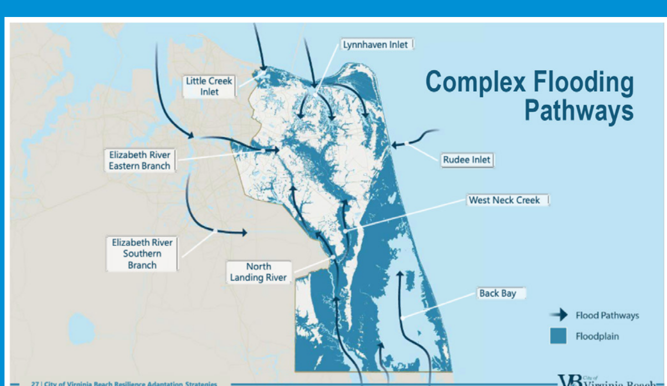
- Whether to expect a drought/ENSO cycle of one year vs. two or more years
  - Projections of timing and rapid switch between dry and wet periods
  - A simple index to alert them of wet and dry conditions in the coming season
- Local drought forecasts—especially modified advisories for agriculture
- Extended weather and precipitation forecasts for about 2–3 weeks
- Better prediction and advanced warnings of heavy rainfall events
- Real-time digital QPF forecasts
  - To feed hydrologic models
- Refined, streamlined hurricane forecast information
  - "There are too many different forecasts"
- Lightning information: e.g., flash density maps and frequencies by time of day, potential future changes in lightning density
  - For safety of maintenance and repair crews
- Accurate wind forecasts



The concept of Spatial Downscaling
Credit: David Viner, d.viner@uea.ac.uk



Integrated Hydrologic Model
Credit: Tampa Bay Water



Complex Flooding Pathways
Credit: City of Virginia Beach, Virginia

Long-Term Weather and Climate Information
For planning, infrastructure design, and preparedness

- Precipitation intensity, duration and frequency projections
- Probabilities of a confluence of low probability, high-impact events
  - Including high tide storm surge, sea-level rise, intense precipitation, and river levels at high tide (the "perfect storm")
- Quantify the range of uncertainty introduced to decision making from the use of multiple Global Climate Models (GCMs) and Regional Climate Models (RCMs)
  - From a range of temporally and spatially downscaled datasets, for multiple emissions scenarios and a range of future time periods

Modeling and Research Needs

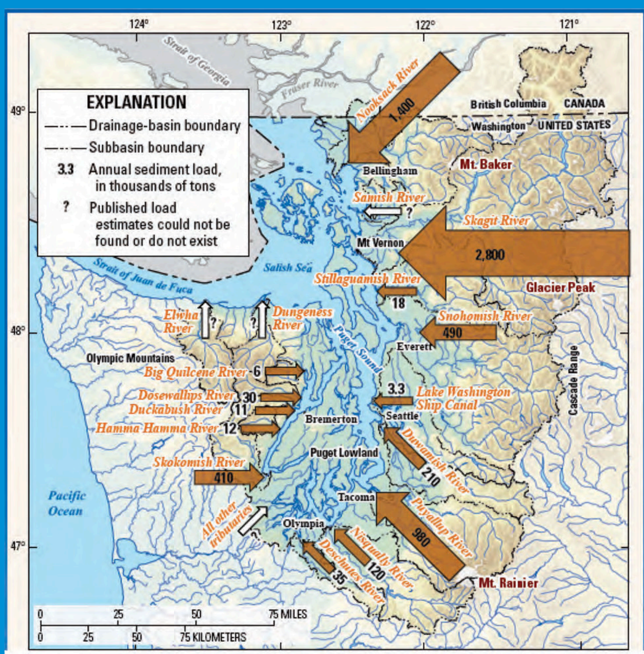
- Improvements in models to pick up small-scale deep convection events
  - For improved storm forecsting and projections of precipitation
- Research on microclimates and on differences in precipitation intensity over metro areas
- Research on cloudbursts/short duration heavy precipitation as a phenomenon
  - To inform decision making and design of stormwater infrastructure
- Understanding precipitation variability and how it connects to runoff
  - For informing decision making and design of stormwater infrastructure

Information and Research Needs: The Intersection of Climatology and Hydrology

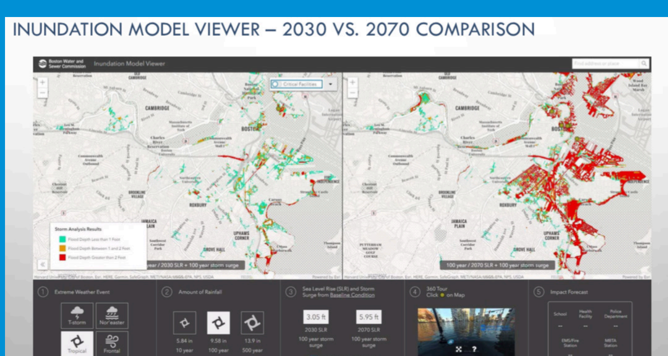
Observational Capabilities: Soil Moisture, Snowpack, Groundwater
For water supply management

- Remotely sensed soil moisture data
- Tracking runoff efficiency trends, increasing soil moisture monitoring and synthesis, and understanding feedback loops
- Tracking vegetation to assess increase or decrease in evapotranspiration
- More Snow Telemetry (SNOTEL) sites especially for mid- and high elevation snowpack and snow water equivalent (SWE)
- Airborne or satellite snow observations and light detection and ranging (LiDAR) to see snow cover and snow water equivalents at higher elevations (above 11,000 feet)
- Tools to map spatial snow products that extend SWE information
- 14-digit hydrologic unit code (HUC) mapping of inter-mountain areas (8-digit mapping less useful)
- Better groundwater data

NCAR scientist Ethan Gutmann walks past a snow gauge at a research site in Colorado
Credit: University Corporation for Atmospheric Research (UCAR)



Climate change concerns: Flood Risk, Sediment Load, Salinity, Water Supply
Credit: City of Anacortes, Washington



Inundation model Viewer, Boston, Massachesetts Water and Sewer District
Credit: Hazen and Sawyer

Modeling and Forecasting Floods

- Real-time flood forecasting for watersheds
- River and stream models to evaluate potential for flooding from confluence of events
- Modified hydrologic and operational models to incorporate climate change information
- Mapping tools and dynamic models to determine impacts of various levels of flooding on communities
  - Tools to overlay physical science with social data to understand vulnerability
  - Toolkit to walk a community through the analysis

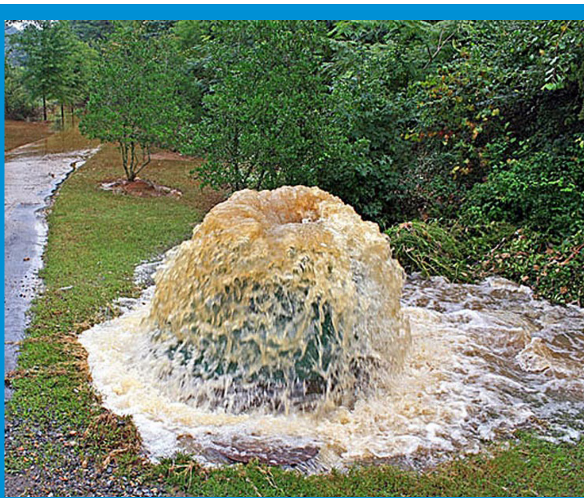
Continuous Engagement: Conveying NOAA Science to Water Sector Decision Makers

Helping Local Water Managers Understand Weather and Climate

- Contextual information around forecasts, extreme weather scenarios, and potential impacts
- Historical context to provide perspective or analogies to past storms
- How to interpret weather forecasts, two weeks out and greater, for heavy rain, drier-than-normal conditions, and temperature anomalies
- Climatology of impacts and vulnerabilities in region, including what it means to water utilities
- Guidance on considering uncertainty in future climate
- Training on use of tools like multi-sensor precipitation estimates (MPE) and CLIMPer
- Guidance on how to integrate capital planning with climate models to ensure new projects are future proof

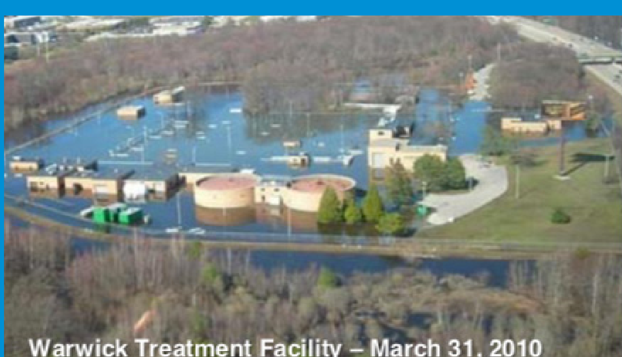
Helping Water Managers Communicate to Decision Makers and the Public

- Actionable information and compelling graphics
  - Information needs to be in a form that can be communicated to decision makers
- Scientific information that is more accessible and digestible for elected officials and the public
  - Including trends and projections (especially rainfall) and its implications
  - Including climate projections and the idea of multiple climate futures
- How to communicate meaning of rainfall probabilities to the public



Combined Sewer Overflow near Atlanta, Georgia, 2009
Credit: Alan Cressler, USGS

Flooding in Virginia Beach, Virginia, 2016
Credit: City of Virginia Beach



NRCC-Warwick flooding
Credit: Warwick Sewer Authority

Making NOAA's Information More Accessible to the Water Sector

- Practitioners are overwhelmed by the sheer amount of data and are unsure how to use information when prioritizing actions
  - A regional climate change information "clearinghouse" to facilitate uptake of information
  - A clearinghouse for all sources of precipitation data from multiple federal sources, e.g., USGS, USACE, NOAA, and more
  - An interface that directs users to particular products
- Water sector practitioners rely on professional networks and peer-to-peer learning
  - Build a relationship in this sector
  - Leverage existing training networks to disseminate education and information

Communicating Meaning

- Links to educate utilities on what goes into a forecast, how information should or shouldn't be used
  - For example, the complexities of drawing conclusions from information on ENSO forecasts
- Quick reference guides to explain the importance of certain weather phenomena—like ENSO and what it means for a particular area, providing examples of extreme years
- Education on impacts of extreme events anticipated from weather forecasts

Data Use and Other Considerations

- Lack of a standard set of best practices incorporating downscaling into hydrologic modeling
- Lack of confidence in results of non-standardized tools especially when the results look like a "black box;" or whether they would be approved by, for example, regulators
- Understanding limits and whether tools incorporate updated information or changing standards
- Need to be able to download data and maintain records

For More information

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